HFACtS REPORTS

A Quarterly Newsletter Reporting Marine Facility Incidents Using the Human Factors Analysis & Classification System

California State Lands Commission — Marine Facilities Division

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UNSAFE ACTS: WHEN DOES TRAINING HELP?

Training can be an effective safeguard against some, but not all, unsafe acts that end in an incident. In devising a prevention strategy, it would be useful to know which unsafe acts can be mitigated with training and which would respond better to other prevention measures. HFACS provides guidance toward formulating an appropriate intervention strategy by classifying unsafe acts into different types, and by identifying other latent conditions that contribute to incidents involving unsafe acts.

The table below shows the distribution of 28 unsafe acts that have been identified with HFACS analysis. The discussion that follows describes each type of unsafe act and the context in which each occurs in order to determine whether training can be effective in preventing reoccurrence.

ERRORS	***% OF UNSAFE ACTS***
Perceptual	*11*
Decision	*46*
Skill-based	*5*
VIOLATIONS	
Routine	*18*
Exceptional	*2*

Perceptual Errors: Examples include misreading of dial and indicator panels, and failure to detect pipeline cracks and leaks during visual inspection. These errors are more likely when the design of the equipment is such that it is difficult to use (a confusing indicator panel) or maintain (a pipeline that is difficult to access). Training will not prevent people from misperceiving things. A better approach aims at the latent conditions involved. Solutions might include changing the design of equipment and work environment to improve useability, assuring that procedures are appropriate for conditions (for example, items in a visual inspection protocol should be visible and accessible).

Decision Errors: Examples include instances where improper procedures are applied, such as bypassing a shut-off valve during fueling, selecting a poor (difficult to manage) filling scheme, connecting transfer hoses with insufficient slack or improper grounding. These errors often result from a lack of knowledge, and can persist in the absence of adequate oversight. Training can be an effective intervention for many decision errors.

Skill-based Errors: Examples include instances of forgetting of steps in a procedure, poorly executed procedures, and inadvertent use of controls. These “slips” often occur when operators are complacent or distracted in conducting an over-learned, repetitive task, but can occur even in the absence of adverse states. Training is unlikely to prevent most skill-based errors. Sufficient staffing levels, adequate oversight, and job aids (checklists that remind operators of procedural steps) are better means of preventing incidents that result from skill-based errors.

Violations: Unlike errors, violations involve the knowing disregard of rules and regulations. Violations are sometimes tolerated by the organization, either because they are not viewed as a significant risk, or because they go unnoticed. A clearly communicated policy for acceptable behavior with consistently applied consequences for those committing violations, rather than training, can be effective in preventing these unsafe acts.

SELECTED CASE: AGING PIPELINE

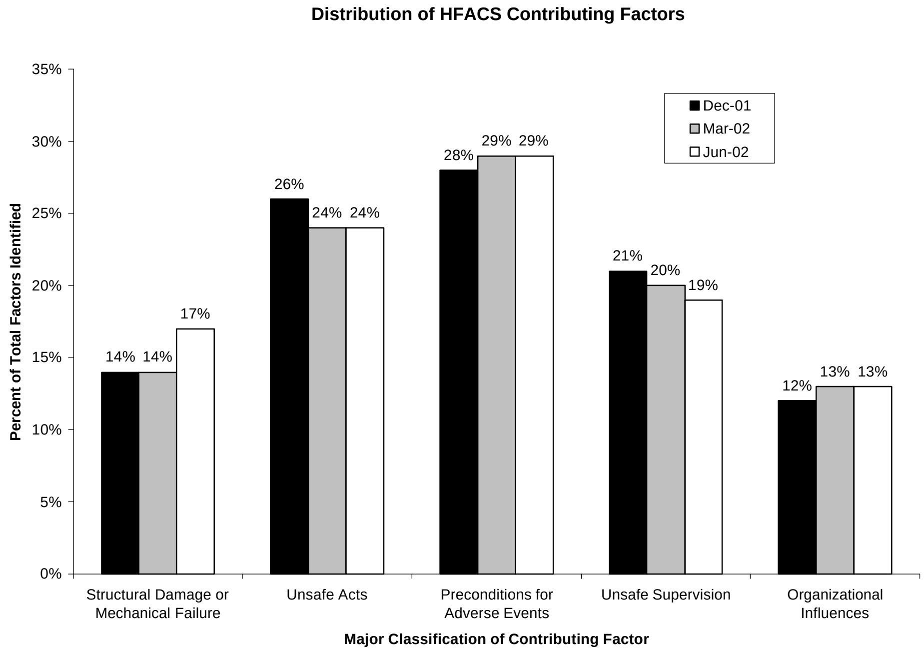
The case example below includes a brief, de-identified narrative description of an actual incident, and a listing of the factors that contributed to its occurrence. These key contributing factors along with the narrative are entered into the HFACS database.

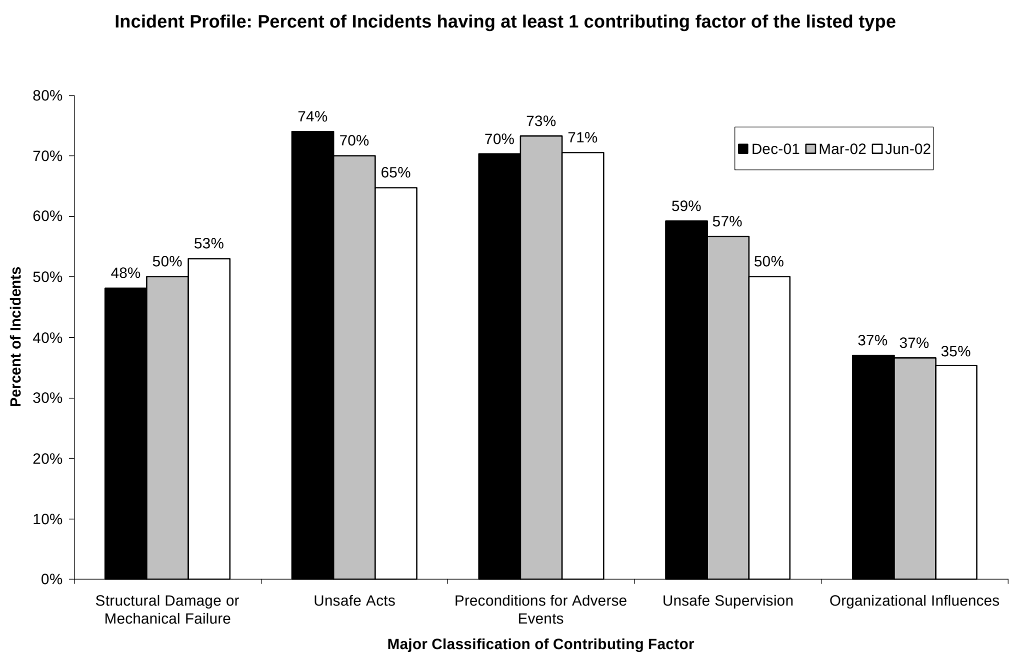
While making fast a vessel in preparation for transfer, terminal crew noticed a continuous stream of black oil seeping from a concrete embankment at water level. Further inspection revealed that the seepage was coming from an area beneath a roadway at the terminal, where an approximately 14-foot underground segment of pipeline was situated. After daybreak, a decision was made to excavate the area under the roadway to a depth of approximately 12 feet. The pipeline was found to be thinned and corroded in several areas, and a one-half inch hole along the pipeline segment appeared to be the source of the leak. The pipeline was nearly 50 years old and a cathodic protection system was installed about 20 years after the pipeline. Records indicated that the cathodic protection system had not been functioning in recent years. The segment was surrounded by soil and near enough to the surface of the roadway to be impacted by vibration. The pipeline withstood static liquid pressure testing applied 10 months prior to the incident. The facility removed and replaced a segment of the pipeline, and plans to move the pipeline segment above ground.

Who/What	Contributing Factor	Classification	Subclass 1	Subclass 2	Detail
Pipeline Segment	formed a hole due to corrosion & surface vibration over a long period of time	structural damage	terminal structure		pipeline corrosion
Underground Pipeline	was vulnerable to accelerated wear given its design and positioning	substandard work interface	substandard design		design substandard for maintenance
Terminal Organization	did not provide terminal management with resources to proactively address aging & vulnerable pipelines	organizational influences	resource management		inadequate design and maintenance of facilities

Note: The facility plans to redesign underground segments of pipeline to be above ground. Ultrasonic testing is not required in regulations, but could have detected the thinned pipeline wall in this case.

DATA: Summary Statistics





Data Notes: *Dec-01 data includes 26 incidents that occurred between May 11th – December 31st 2001. This is updated with an additional case that was completed since the last issue of HFACtS Reports. The Mar-02 figure reflects 30 incidents, adding 4 that occurred during the first quarter of 2002, and the Jun-02 figure includes 4 that occurred in 2002.*

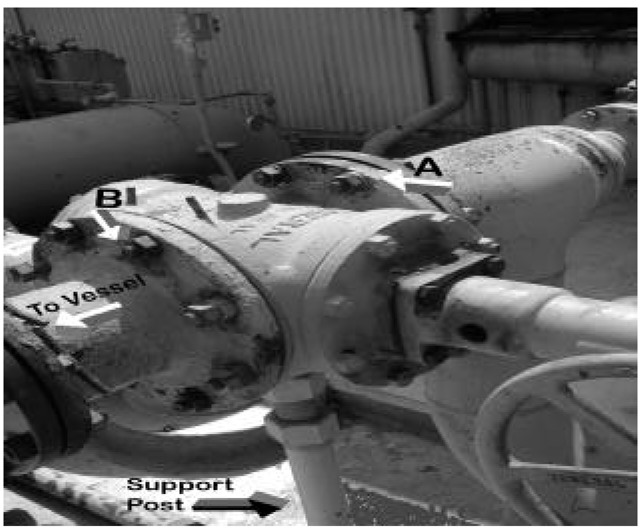
Quick Fact

- Unsafe supervision was identified as a contributing factor in 59% of events (13 of 22) in which an unsafe operator act led to an incident.
- Less than 1 barrel of oil spilled into the water in 87.5% of the 24 spill incidents analyzed to date.

PROBLEMS & SOLUTIONS

REDUCING THE RISK OF ELECTRICAL ARCING

Regulations require that all metal on the vessel's side of a transfer connection be electrically continuous with the vessel and that all metal on the terminal's side be continuous to the terminal's grounding system. Terminal and vessel sides must also be electrically isolated from each other either through the use of an insulating flange joint or a single length of non-conducting hose, in order to mitigate the risk of electrical arcing and the potential for ignition of transferred products. State Lands Inspectors have often encountered connections that do not meet the requirements described above, including: (1) improper grounding, due to either insulating flange kits being improperly



An insulation sleeve is incorrectly positioned at location A. Because the support post touches the dock, there is electrical continuity between the terminal and vessel, which introduces a risk of electrical arcing. Moving the sleeve from point A to point B would electrically isolate terminal and vessel, resolving the problem.

placed (see photo) or the vessel side of a transfer hose touching the dock (Figure 1); or (2) non–conducting hoses being supplied by a barge and a terminal-side insulating flange is not disabled, or is

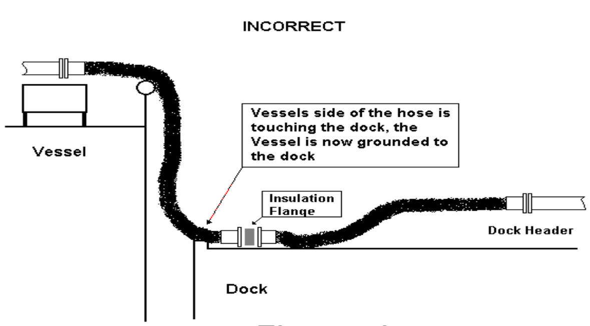


Figure 1

not re-enabled when a conducting hose is used in a subsequent transfer (Figure 2).

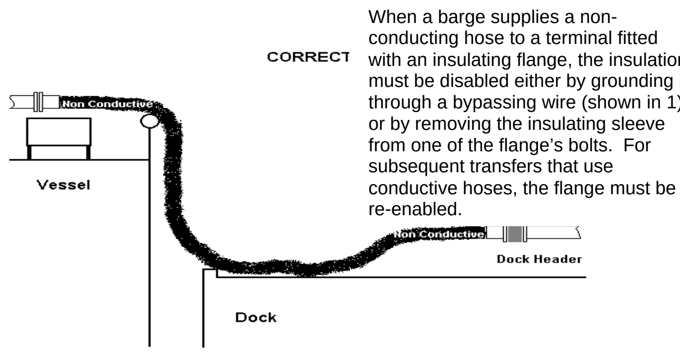


Figure 2

Solutions can be found in the pattern of active failures and latent conditions that contribute to these incidents. Two patterns emerge. In one, the operator omits a step in pre-transfer procedures (either failing to check on the type of hose used in the transfer, or failing to check the status of the insulating flange kit). This is an unsafe act made more likely by the pre- transfer conference that precedes it, in which TPIC and VPIC do not adequately brief one another on the status of hoses and connections. In the other, the operator makes a poor decision to prepare the transfer connection without regard to the risk of electrical arcing – not because of a procedural misstep, but because the operator is unaware of the risk of electrical arcing in the first place.

The former pattern represents a case in which a **substandard practice of operators** (poor communication during briefing) triggers a **skill-based error** of forgetting a step in a procedure. *This could be addressed by incorporating specific items into the Declaration of Inspection (DOI) that reminds operators to: (1) identify the types of hoses that will be used in the transfer; and (2) check the status of insulating flanges and ground connections.*

In the latter pattern, **a substandard condition of the operator** (lack of knowledge) triggers a **decision error** of connecting hoses without regard to proper insulation and grounding. *This could be addressed by providing training, rather than a DOI reminder, that describes the risk of electrical arcing and relates it to specific equipment, vessels, and transfers at the facility in question.*

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This HFACtS Reports is available online at: http://www.slc.ca.gov/Division_Pages/MFD/MFD_Home.htm

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